

Organizing maintenance management activities in the industrial company

Georgi Kondev^{1*}, Stilian Stefanov²

¹University of Chemical Technology and Metallurgy, 8 Kl. Ohridski, 1756 Sofia, Bulgaria

²University of National and World Economy, Students Town "Hristo Botev", 1700 Sofia, Bulgaria

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ABSTRACT

This article presents general information and guidance for organizing maintenance management activities in an industrial company. A brief description of the process of gathering information on the current state as a preliminary stage has been made. The authors also examine the subsequent preparation of the necessary financial resources, the maintenance planning and the monitoring progress in its implementation. Depending on the individual characteristics of the organization, maintenance management could include different stages, activities, procedures and software combined into an overall efficient system. On the other hand, the basic principles followed in the maintenance management of all systems are similar to those summarized in this article.

Keywords: maintenance, quality, organizing management.

INTRODUCTION

The management of repair and maintenance in an industrial company is a well-structured systematic approach that includes planning, organizing, monitoring and evaluation of activities and associated costs. Establishing of a flexible and effective system of maintenance of equipment, which is collateralized with experienced and qualified personnel leads to improvements in several directions. In the first place, this system achieves and preventively avoids possible danger to life and health of people and environment. Secondly, it increases the reliability and reduces the physical wear of assets used by decreasing

the number of accidents and shutdowns of the production process. Hence, it could also lead to lower operating costs, increased motivation and quality of life in general.

Maintenance impact on the organizations performance

In today's economic environment one of the key business processes, which affects the performance of the organizations is the repair and maintenance of the equipment, machinery, etc. From the perspective of competitiveness, and the search for competitive advantage manufacturers of machinery, equipment and apparatuses are focused on reduction of production losses, enhancement

* Correspondence to: Georgi Kondev, University of Chemical Technology and Metallurgy, 8 Kl. Ohridski, 1756 Sofia, Bulgaria, E-mail: kondev@uctm.edu

of products quality, environmental protection, correct execution of orders to customers, reduction the cost price, increased reliability etc. Therefore, the corporate strategy of the organizations activities focus over the past few years on new products development and engineering together with production and maintenance management. Moreover, performance maintenance activities and optimal functioning of the equipment occupies a leading position in management in certain sectors of the economy. Today, from managerial and logistical standpoint, maintenance management activities perform a strategic role in organizations. Their effective implementation ensures high reliability of the plant and equipment during the operation, which would lead to a reduction of the production costs. In this area of management, a number of methods and techniques that improve efficiency and minimize losses, such as Reliability Centered Maintenance (RCM), Total Productive Maintenance (TPM), Failure Mode and Effects Analysis (FMEA) are widely used.

The implementation of those techniques usually involves the establishment of a team of experts of a different competency profile. Therefore, the team employees can successfully overcome the existence of constraints and contradictions that exist in the management system accepted. This will significantly facilitate the operation of the maintenance management system based on improved communication, coordination, and integration. The key objective refers usually to the implementation of activities leading to a reduction of the reaction time in case of people management of processes, machines and equipment. These teams are a powerful mover within the organization that successfully combines different formal and informal groups into a single structure. Teamwork decision-making and implementation of activities contributes to greater motivation, engagement with corporate objectives, as well as strong social and emotional engagement of individual employees.

The effective work of the members of the team, the better planning of the activities, the selection of appropriate software solutions, the performance indicators, tools and management

techniques are associated with two key areas or directions. The first one refers to the establishment and use of an appropriate model, which describes the maintenance management activities. This requires a comprehensive study of the best practices in that area. The second one is connected with the accurate and clear identification of the current state of the organization in terms of maintenance. Upon completion of the work in the areas mentioned above, the team proceeds further to implement the maintenance management activities in correspondence with the main functions affecting the performance. They include:

- Full commitment of the team members in respect to their obligations and responsibilities in the course of maintenance management;
- Development of an appropriate corporate culture corresponding to the corporate goals and organizational profile;
- Establishment of appropriate communication channels and effective management of information contained therein;
- Implementation of appropriate methods and tools for conflict management in times of crisis.

Achieving a sustainable improvement of the organization key indicators referring to the maintenance activities is difficult. It requires totally enforced activities related to distribution of the above functions, practical knowledge and reference numbers in all departments and units in a particular timeframe.

The size of maintenance costs required is a crucial factor when choosing the time to implement the maintenance activities sequence in the different structures. They represent a major part of the overall costs of the industrial and commercial organizations. Depending on the individual characteristics of a particular industry the cost of maintenance can reach 20 % to 60 % of the cost of the final products. For example, about 20 % of the cost in the food industry is due to maintenance costs, while the expenses increase to 60 % in metallurgy, pulp and paper, heavy chemistry and other similar industrial branches. For other industries, such as petroleum and electricity production, mining, the maintenance costs can go beyond the overall operating costs.

That is why the optimization of maintenance management becomes the primary task of the contemporary management. This leading role of maintenance is enhanced by the continuing complexity of manufacturing processes and the rapid penetration of technological innovations, which by themselves lead in recent years to an increase of the maintenance costs. In this situation, the top management should pay special attention to the arrangements related to the implementation of maintenance activities. This would improve the overall efficiency and effectiveness using optimally constrained resources for maintenance of the equipment. The primary objective regarding costs associated with maintenance activities and their standardization refers to the creation of a coherent strategy for equipment maintenance. The activities assessment should comply with the following criteria:

1. Optimal costs of the maintenance activities referring to the availability of the necessary components;
2. Provision of maintenance ensuring the existing staff as well as the environment's safety;
3. Achievement of high equipment reliability and the high products or services quality.

In case of such strategy the maintenance activities are associated with operations, work, services, supply of materials, spare parts, energy, etc. The objective is to ensure optimum functioning of an asset for a given period of time, while retaining the quality of the manufactured products. For example, in some metallurgical processes, the optimal operation of the converter is related with the quantity of extracted intermediate product. The prolongation of the working time through predictive diagnostics activities can reduce the share of the above-mentioned expenses in the cost of the final product. The maintenance management activities in this case as well as in other sectors like chemical industry and metallurgy have a direct impact on the cost of operation of the asset. Thus management maintenance activities generally include work carried out by people or assets. The key objective is to maintain the original performance characteristics of the equipment for a certain period of time. The

activities referring to the equipment maintenance which should not contradict the overall corporate strategy have to be well described. They include:

- Everyday activities that ensure extended utilization of the equipment, i.e. current operations connected with cleaning and lubricating of individual components, securing moving parts, etc.
- Preventive activities like periodic inspection, adjustment and replacement of parts or assemblies to ensure high reliability under working conditions.

- Predictive activities referring to continuous and periodic monitoring and evaluation of critical equipment operation elements that indicate the current status and reliability of the equipment.

- Emergency activities, i.e. operations to eliminate unexpected failures of assets or equipment. These activities are not planned and are difficult to predict and which is why the maintenance should focus on the activities mentioned above.

The activities connected with maintenance or repair of an asset cover not only the replacement of broken/ damaged parts, but also the provision of people of knowledge, skills and assessment of financial resources. Deviations from the optimum performance can result from normal wear and tear, vandalism, abuse, malfunction and others.

Management of the organization maintenance

A thorough and competent creation and construction of an appropriately working system for management of the maintenance activities require an extensive work by a team of specialists in this area. Once implemented, the maintenance activities provide accumulation of a data that can be used when planning future improvements. The necessary changes are focused mostly to the introduction of additional activities increasing the efficiency or reducing the maintenance costs that can be adjusted to the corporate level planned. The management activities need to be evaluated and reviewed in terms of cost of labor, equipment, materials, spare parts and time. Various software products that facilitate the effective management of the activities at present or future terms are used for their assessment.

People responsible for managing the maintenance activities should monitor progress daily, weekly or monthly depending on the situation and the impact on the organization, the environment or society as a whole. If necessary, corrective actions should be carried out at the right time rather than waiting for the end of the relevant month or year. Then it could be too late, especially in a similar dynamic economic environment. Such activities leading to significant changes in labor costs, materials or other common expenses should be clearly described and documented to achieve easy traceability in time. The head of activities should determine the cause of deviations on the ground of elaborated alternatives or activities leading to a reduction of cost and time. The acceptance and implementation of these proposals will help to improve the efficiency and effectiveness of the management activities in the industrial maintenance company. These activities are in a broader sense an integral part of the daily operations performed at the company. They represent a set of actions, rules, procedures and instructions of the maintenance system. It contains also the objectives of the maintenance team or those of an external organization if its service is required.

Through a set of standards and internal company procedures the management maintenance establishes short-, medium- and long-term goals and objectives. They are mostly associated with better use of available resources, people, materials, equipment, information, etc. Modern management in this direction should include a clear mission and vision, which in turn have to outline the possibilities of regulating the processes of maintenance for full satisfaction of the customers as a result of producing high-quality products and services.

In this context, the management of maintenance should be considered a strategic function when is oriented to key business outcomes of the organizational performance. For example, General Electric has set itself as a key objective to expand the proactive maintenance and reduce the corrective maintenance or unplanned work. The goals refer to 42 % of preventive maintenance, 42 % of predictive maintenance and 16

% of corrective maintenance [1]. Thus,, in this line of thinking, it is not enough just to provide functional reliability of the equipment used in the manufacturing process. It is necessary to assess the impact on the occupational safety, the environmental factors, and the cost aiming to achieve in future goals similar to those set out in the context of a sustainable development.

The rapid penetration of such modern paradigms and concepts would lead to implementation of major innovations in management maintenance activities. Such change is critical because maintenance is related to the profitability of the production process connected with the volume and quality of the products and the costs performed. That is why reformulation of maintenance purposes must be strongly linked to the overall objectives of the organization. Two leading concepts can be viewed as limitations. On one hand, the objectives are greatly focused on the improvement of the effectiveness, efficiency, reliability and availability of the equipment, while on the other one the costs related to the management process of activities leading to the improvement of those indicators cannot be excluded. But the search for a sustainable balance between the benefits of maintenance that improve the overall profitability and increase the costs and deployment activities among all stakeholders is a key element in this situation. This balance, when achieved, ensures success and good management of maintenance at the organization.

The successful organization of maintenance management activities in the industrial company requires an individualized approach consistent with the complexity of manufacturing operations and the scope of activity of the organization. Some of the activities are related to the acquisition of general theoretical knowledge of maintenance philosophy like planning and coordination, people management, knowledge of equipment and assets, lubrication and adjustment, management of materials and spare parts, knowledge of computer technology and software engineering, production management and quality management.

Direct and/or indirect connections between

the maintenance management activities and the principles enshrined in the fundamentals of quality management can be easily made from a holistic perspective. According to authors like F. Crosby, quality is defined as conformity to product requirements. Thus quality is achieved through preventive action, but not by checkup or control. The presence of „zero defects“ is considered a representative standard, while the quality is measured by the cost of the discrepancy achieved.

From the standpoint of maintenance, the quality is closely linked to the performance of activities for systematical error prevention that could lead to an accident or production process shut down. The implementation of such preventive operations is directly related to the strategy for the so called „total productive maintenance“. The achievement of „zero defects“ in maintenance is a modern paradigm whose goal is to reach excellence through the use of innovative management techniques in line with the corporate strategy. The performance evaluation in terms of maintenance requires no need for intervention or correction. From that point of view optimal are those maintenance management activities which combine and use different methods and techniques. Their choice depends on the characteristics and importance of the equipment for the manufacturing process. The goal usually is to achieve economically viable efficiency and effectiveness.

Models for maintenance management

The implementation of any maintenance management model requires a policy directed to preventing and/ or eliminating the possibility of occurrence of adverse events (accidents). The inadequate execution of such a policy aimed at better implementation of the maintenance activities should be defined as a failure for the participants of the team. Most often this is associated with the presence of abnormal working conditions, which endanger the performance of the entire production system. The regulation in this case is associated with observation of the measurable parameters and provision of actions to return process to the limits defining a normal operation of the equipment. These objectives set

out in the maintenance management model are defined as preservation of the functionality of the equipment and the production systems. The proper maintenance should ensure reliability in the performance of the planned functions by individual's assets in accordance with the consumers demands. Maintenance itself actually achieves the goals by implementing preventive actions which proactively predict potential critical work occasions. They could lead to accidents or production losses related to the amount of quality production, increased costs of operation, reduced profit margins and others. Moreover, achieving world class maintenance requires continuous improvements of already implemented activities and operations in this direction. These improvements follow the progress achieved by the competitive maintenance policy accepted by the top management of the organization. The actual assessment of the current situation allows the senior management to implement corrective, preventive, predictive or autonomous maintenance actions, and combinations thereof. The word „maintenance“ is at the center of each of these techniques. The difference is found in the various instruments used to achieve the organizational goals, i.e. total production maintenance, maintenance based on the reliability, maintenance based on the conditions, etc.

Maintenance management activities

A clear and precise definition of the maintenance activities is essential to its effective management. The results in terms of maintenance achieved upon activities execution are usually compared with the targets set previously by the company management. A set of indicators, developed by the maintenance managers in conformity with the individual characteristics of the organization, are used for this purpose. Indicators of different content and meaning are advanced in the world literature. Often they are adapted to the specific needs of a particular organization. Activities in one or more of the areas of asset management, people management, planning and organizing of maintenance, performing the maintenance, assessment of costs and documentary

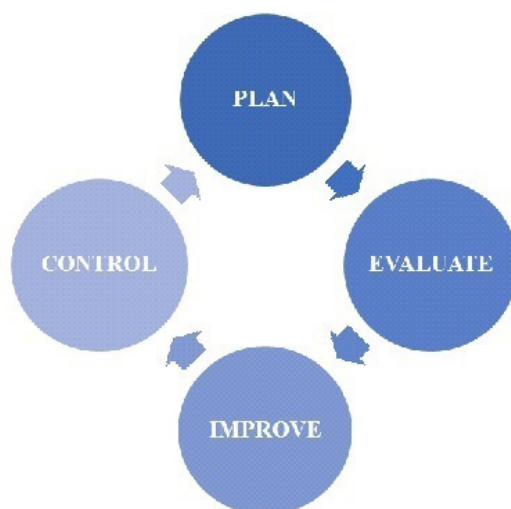


Fig. 1. Cycle of maintenance management activities at an industrial company.

accounting maintenance should be combined.

The subsequent improvement of those activities leads to achievement of excellence in maintenance, which involves identifying and adapting the existing world best practices in area. This primarily means to develop and implement a new philosophy and change in thinking and performance among all employees. A similar process takes time, people involvement and repeated passing through modification of the well-known cycle of “Deming” (Plan - Do - Check - Action), which in the context of maintenance has the following sequence “Plan - Evaluate - Improve – Control” (Fig.1)

The effectiveness of the maintenance activities results from complex operations that could be evaluated by appropriate indicators measuring actual against expected results [2] in accord with standard BS EN 15341: 2007 (Maintenance. Key Performance Indicators). The indicators are necessary to ensure the greatest possible stability and predictability of the maintenance processes in the organization. They represent quantitative (numerical) data, and usually describe the processes observed or the subject that has to be under control and maintenance. Generally they refer to the equipment availability, the costs, the production losses caused by the maintenance activities, the repeated operations, the mean time between failures (MTBF), the mean time between

two repair (MTTR) and the overall equipment effectiveness (OEE). When managing the maintenance activities additional costs are assessed against the embedded kind of maintenance. In case maintenance is carried out reactively in particular department or unit, the application of unplanned corrective maintenance is associated with higher costs. Often, however, to spend a minimum cost is not the best solution and cannot guarantee the achievement of the highest value (benefit) of a product or service.

The construction of maintenance strategy and planning activities has to take into account the employees knowledge and skills as well as other operating resources (tools, parts and equipment). The subsequent measurement of the results obtained in the course of realization of the operations and maintenance is meaningless and a useless activity if it is not supported by future changes leading to performance.improvement. The accepted policy for equipment maintenance, the strategy for preventive action and the subsequent operational management should ensure balanced improvement of key indicators assessing the performance (KPI).

The industrial company managers could use the popular instrument called Balanced Scorecard offered by Norton and Kaplan for additional identification of measures taken in management processes in terms of maintenance. This popular

methodology should be directed at aligning the strategy adopted by maintenance activities at the operational level. The analysis of the past results should be the ground of the effort focused on the implementation of future measures leading to maintenance improvement.

CONCLUSIONS

The effective organization of maintenance management activities is related to studying and analyzing the work processes of planning and monitoring. This would identify the most appropriate resources, tools and techniques for optimal implementation of maintenance in an industrial company. The establishment of an adequate governance model, which takes into account the individual requirements of the company, will help the managers to draft a strategy for maintenance, and to select the techniques and indicators reflecting the progress at each level of government.

Achievement of high efficiency after the organization and execution of maintenance activities in the industrial business is a complex and dynamic process. It depends mainly on the adopted strategy for maintenance management, the available equipment, the staff qualification, etc. Furthermore, the basic knowledge on the operation of the equipment and certain points which are critical for optimal functioning has to be thoroughly studied. Thus the employees could use modern tools and techniques to influence the causes rather than the consequences at work.

The rapid development and increased use of sophisticated software solutions and computer systems does not lead in most cases to simplification of the management activities of maintenance.

This is because the employees lose a lot of time and other resources in the planning phase, in making analysis and backup of the relevant information. On the other hand quick response and commitment of the necessary maintenance is required to organize the activities in a fairly simple, clear and easily understandable system. One of the objectives of the ongoing future research is the development of specialized software which enables flexible changes in terms of critical equipment operation parameters. Some of the possible one refer to the frequency of accidents, the response time and the resolution of a problem, the reliability, the repair costs, etc. The collection of such information in the appropriate database will support managers in creating plans to deal with emergencies, maintenance of existing repair tools, etc.

More and more companies from various sectors of the economy have a basic level of activities in maintenance management. This means that they have a chance to carry out numerous continuous improvement steps in maintenance, and to set ambitious strategic goals. Thus they can improve their competitiveness by increasing productivity and reducing losses.

REFERENCES

1. Reliability Based Maintenance (RBM) Using Key Performance Indicators (KPIs) To Drive Proactive Maintenance, Robert Ford, CMRP, GE Power Generation Services, 4200 Wildwood Parkway, Atlanta, GA 30339 USA.
2. EN 15341, 2007. Maintenance - Maintenance Key Performance Indicators. Brussel: CEN - European Committee for Standardization.